

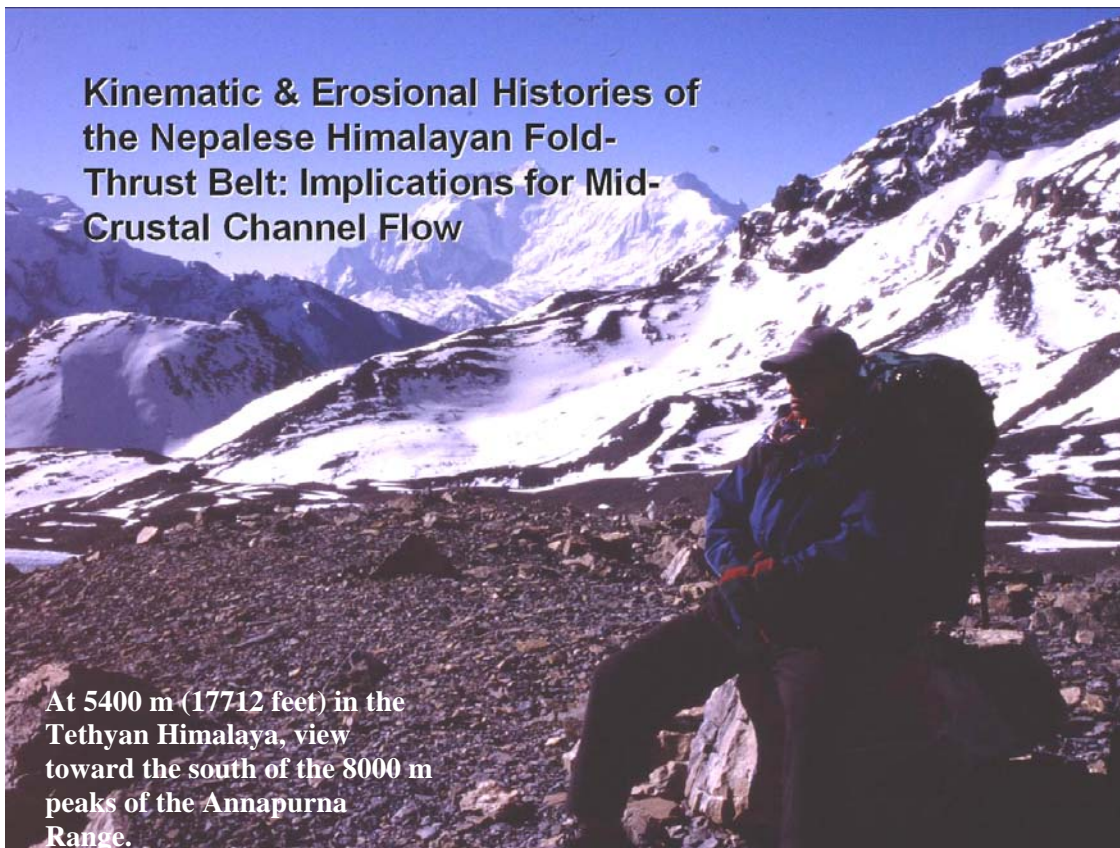


## ***Colorado Scientific Society***

*The objective of the Society is to promote  
The knowledge and understanding of Earth science,  
And its application to human needs*

### ***S.F. Emmons Lecture***

**Kinematic & Erosional Histories of  
the Nepalese Himalayan Fold-  
Thrust Belt: Implications for Mid-  
Crustal Channel Flow**



At 5400 m (17712 feet) in the  
Tethyan Himalaya, view  
toward the south of the 8000 m  
peaks of the Annapurna  
Range.

**Dr. P.G. DeCelles**

**Department of Geosciences  
University of Arizona, Tucson, Arizona**

**Thursday, January 19, 2006**

**Colorado School of Mines Green Center, Metals Hall  
924 16<sup>th</sup> St (between Illinois and Arapahoe), Golden  
Social half-hour – 7:30 p.m. Meeting time – 8:00 p.m.**

## **Abstract**

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# **Kinematic and Erosional Histories of the Nepalese Himalayan Fold-Thrust Belt: Implications for Mid-Crustal Channel Flow**

By Pete DeCelles, Department of Geosciences, University of Arizona, Tucson, Arizona

Regional structural mapping, thermochronology, provenance analysis of foreland basin deposits, and incremental restoration of balanced regional cross sections of the Nepalese Himalayan fold-thrust belt provide the basis for an assessment of recently proposed mid-crustal channel flow (MCCF) models for Himalayan geodynamics. As currently articulated, MCCF requires southward extrusion of mid-crustal rocks from beneath the Tibetan Plateau to daylight at an erosional “porthole” sandwiched between the Main Central thrust (MCT) and South Tibetan detachment (STD). The model predicts that (1) the STD and MCT have comparable slip and do not join in the subsurface; (2) the rocks currently exposed in the Greater Himalayan zone would have been involved in ductile extrusion during Early Miocene time (although some versions of the model call for present-day channel flow); (3) incorporation of Indian rocks into the channel from below the MCT is a turbulent process, resulting in mixing and structural overturning; (4) Tibetan mid-crustal rocks have been involved in the channel since its inception; and (5) the present outcrop of Greater Himalayan rocks has served as the erosional porthole throughout development of the channel. These features are testable with existing geological data from the Nepalese portion of the fold-thrust belt.

Detrital U-Pb zircon ages, Nd-isotopic data, and conventional petrographic data from foreland basin deposits in Nepal show no evidence of erosion of Tibetan mid-crustal rocks from Eocene to modern times. Conspicuously absent are Cretaceous zircons, juvenile Nd, and volcanic lithic grains, all of which would be expected derivatives from middle crust of the Lhasa terrane in southern Tibet. In view of the fact that Greater Himalayan rocks were transported >150 km southward during Early Miocene time, this indicates that MCCF, if it exists in the Nepalese Himalaya, must be confined to

Indian material. Although Greater Himalayan age zircons, Nd-isotopic signatures, and abundant plagioclase appear in the detrital record ca. 22-20 Ma, there is no evidence for erosion of Greater Himalayan medium- to high-grade metamorphic rocks until Late Miocene time (11 Ma). Structural data indicate that the Greater Himalayan rocks were emplaced by the MCT along an extensive regional flat upon essentially undeformed (but metamorphosed) lower Lesser Himalayan rocks, and the present position of the Greater Himalayan topographic front is not coincident with the southward extent of the original MCT sheet. The present, steeply northward-dipping surface outcrop pattern of Greater Himalayan rocks in central and western Nepal resulted from erosion into a regional scale antiformal duplex in Lesser Himalayan rocks that began to develop in Late Miocene time. Thus, the presently configured erosional porthole could not have begun to exist until the Late Miocene. The structural facing directions of Lesser Himalayan rocks below the MCT (the floor of the channel) are consistently upright and northward, precluding turbulent mixing along the base of the channel.

A variety of datasets support the following kinematic history of the Himalayan fold-thrust belt: Eocene-Oligocene thrusting in the Tibetan Himalaya, accompanied by amphibolite-grade metamorphism in the underlying Greater Himalayan rocks; Early Miocene emplacement of the MCT sheet and contemporaneous, but much lesser magnitude, northward slip on the STD; Middle-Late Miocene (post-12 Ma) emplacement of the Ramgarh thrust sheet; Late Miocene growth of the Lesser Himalayan duplex; Pliocene-Pleistocene slip on the Main Boundary thrust; and Pleistocene-Recent slip on thrusts within the frontal Subhimalayan imbricate belt. Considered alongside the detrital unroofing record, this kinematic history is incompatible with large-scale involvement of Tibetan middle crust in channel flow as currently

articulated in the literature. Features often considered as diagnostic of MCCF in the Himalaya (such as ductile shear strain and out of sequence thrusting) are equally compatible with critical taper models of thrust belt behavior. On the other hand, a

modified MCCF model involving only Indian material south of the Indus suture zone since mid- to Late Miocene time may be compatible with geological data as well as conventional kinematic models for thrust belts.

## **Colorado Scientific Society President's Note January 2006**

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*By Chuck Kluth*

### **Help!**

The Colorado Scientific Society is known for our great talks and for our field trips and for being inexpensive. We do a lot of other things as well, such as scholarships, and work with science fairs. We can do all those things because of the generous volunteers of the Society. These people realize that the CSS is a worthy way to give something important back to the geologic and the general science communities. And it's fun.

The Colorado Scientific Society needs your help. We have several opportunities to help on committees. From meeting and scheduling the excellent speakers, to helping choose and organize

the fabulous field trips, to helping with family night, student presentation night and outreach. We can each give back a little effort as part of a committee, so no one has to contribute all of the effort to keep us going. Please contact me if you are willing to pitch in a bit, and let me know what kinds of things you'd like to do. We have outstanding and enthusiastic people to work with but we need more.

We are starting another new year! Time to get started on making 2006 a great one. If we don't, no one will. The Colorado Scientific Society needs your help this year

### **It's Time to Pay Dues for 2006**

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If you have not yet paid dues for 2006, the submittal form is on the next page. Thanks!



## 2006 DUES & FUNDS CONTRIBUTIONS COLORADO SCIENTIFIC SOCIETY

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**DUES:** Dues are for the calendar year (January-December)

Regular Members (\$20, CO Front Range) \_\_\_\_\_  
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**ENDOWMENT FUND:** This fund is used to support the Society's monthly meetings and newsletter, field trips, family night, annual Emmons Lecture, and special activities. \_\_\_\_\_

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# Earth Science Meetings and Talks



*Newsletter items must be received by the 25th of each month. Items may include special events, open houses, etc...thanks!*

**Colorado Scientific Society's** regular meetings are held the 3rd Thursday of the month at the American Mountaineering Center in Golden (unless otherwise advertised). Social time begins at 6:30 p.m. and talks start at 7:00 p.m. For more information, contact Chuck Kluth at 303- 904-2939, [kluth@earthlink.net](mailto:kluth@earthlink.net)

**Denver Mining Club** meets every Monday (except when noted) at Country Buffet near Bowles and Wadsworth (at 8100 W. Crestline Ave., Littleton) 11:30 a.m.-1:00 p.m. Jan 9, "Ingots—Footprints in metal-mining history", by Fred Barnard, Western Mineral Appraisers. Jan 16, "The future of renewable energy", by Irena Bulkley-Hopkins, NREL. Jan 23, "Win some, lose some: the evolution of mining practice on the Comstock Lode", by Gene Michal, AMAX. Jan 30, "Metallica – an overview", by Richard Hall, President, Metallica Resources. <http://china-resources.net>.

**CSM SEG Student Chapter**, Feb 10-11, Short course—Diamonds, by Dr. Karin Hoal, CSM Geology Museum, 13<sup>th</sup> and Maple, 8:30-4:30.

**Colorado AIPG December and annual meeting** Reception at 11:30; lunch and speaker, noon to 1:30. University Club, 1673 Sherman St, Denver. Jan 17, "The Alamo impact breccia of Nevada and the quest for the crater", by Dr. John Warme, CSM. \$23 w/ advance reservation, \$25 at door. Contact Tom Cavanaugh by C.O.B. on December 9 for reservations at 303-425-1125 or at [cavtrac@comcast.net](mailto:cavtrac@comcast.net) or [tcavanaugh@ogenvironmental.com](mailto:tcavanaugh@ogenvironmental.com).

**Denver International Petroleum Society** meets the second Friday of each month at the Wynkoop Brewing Co., 18th and Wynkoop Streets. Reception at 11:30 a.m., lunch at noon, talk at 12:30 p.m. Make reservations (required) by leaving message at (303) 623-5396. Reservations accepted until 10:30 a.m. on Wed prior to the meeting. Cancellations accepted until 11:00 am Wed prior to the meeting. Cost: \$15 for lunches; talk only-\$2. Contact Keith Murray at (303) 986-8554 for info.

**Denver Region Exploration Geologists' Society (DREGS)** meets in the Mutual Consolidated Water Building, 12700 West 27th Avenue, Lakewood. Social hour 6:00-6:30 p.m. Technical presentation at 6:30 p.m. Meetings are normally the first Monday of each month. Jan 9, "Worldwide Uranium Resources", by Dr. Karen Wenrich, Wenrich Consulting for U. For information contact Jim Piper, (303) 932-0137, or the website <http://www.dregs.org>.

**Denver Well Logging Society (DWLS)** meets on the third Tuesday of each month, Sept. through May. Lunch and a technical talk at the Wynkoop Brewery begins at 11:30 a.m., 18th and Wynkoop Sts. in Denver. Subject matter usually deals with the application of well logs to oil and gas exploration. Call Elice Wickham at 303-573-2781 for reservations. Web page: <http://dwls.spwla.org>.

**Rocky Mountain Association of Geologists (RMAG)** Reception at 11:30 a.m., lunch at noon., talk at 12:30 p.m. Reservations are taken by recording at 303-623-5396 until 10:30 a.m., Wed. before the luncheon. Cancellations are taken until 11:00 a.m. on Wed. at 303-573-8621. Luncheon cost is \$20 payable to RMAG at the door. Talk only (no reservations)—\$3. Meeting location: Denver Petroleum Club, Anaconda Tower, 555-17th St, 37th floor. Web page: <http://www.rmag.org>.

**Rocky Mountain SEPM** Reception at 11:30, lunch at noon, speaker at 12:30. Reservations, Dave Uhl:303-389-5092 before noon of preceding Friday. \$15.00 lunch, \$3 talk only. Wynkoop Brewing Company, 1634 18<sup>th</sup> St., Denver. [David.uhl@EnCana.com](mailto:David.uhl@EnCana.com).

**University of Colorado at Boulder, Geological Sciences Colloquium** Wednesdays, 4:00-5:30 p.m., Rm. 180.Refreshments at 3:30 pm on the 3rd floor. For more information, call 303-492-8141. Web page: <http://www.colorado.edu/GeolSci>.

**Friends of Dinosaur Ridge** Fireside chats resume in the fall. Web page: <http://www.dinoridge.org>. Admission is free, but donations are welcome. For more information please contact the FODR Visitor Center at (303) 697-3466.

**Colorado School of Mines, Van Tuyl Lectures** Fridays from 3:00 p.m. to 4:00p.m. in Berthoud Hall room 108. For further information, check <http://www.mines.edu/academic/geology/calendar>.

**USGS Geologic Division Colloquium.** Thursdays, 1:30 p.m., Foord Room, Building 20, Denver Federal Center. For more information contact: Peter J. Modreski, U.S. Geological Survey, Denver, Colorado tel. 303-202-4766, fax 303-202-4767 email [pmodreski@usgs.gov](mailto:pmodreski@usgs.gov).

**For a constantly updated, online geo-calendar, visit the Colorado Geological Survey at**  
<http://geosurvey.state.co.us>

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